WM DOCKET CONTROL
CENTER

'85 MAR 13 A1:54

March 7, 1985

Dr. Jerome R. Pearring, NMSS
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Dr. Pearring:

Please find enclosed the requested technical review of BMI/ONWI-539.

Also find enclosed the Table of Contents of a recently published Symposium, Salt & Brines '85, that should be of interest to anyone working on salt repositories.

Yours very truly,

J. Daemen

J. Daemen
5729 E. Baker St.
Tucson, AZ 85711

Encs.

WM-RES
WM Record File A1755
SNL

WM Project 10, 11, 16
Docket No.
PDR ✓
LPDR ✓(B, N, S)

Distribution:
J Pearring

(Return to WM, 623-SS)

8504100033 850307
PDR WMRES EXISANL
A-1755 PDR

1919

DOCUMENT: "Nuclear Waste Repository Simulation Experiments, Asse Salt Mine, Federal Republic of Germany: Annual Report 1983" BMI./ONWI-539, by T. Rothfuchs and D. Lubker of Gesellschaft fur Strahlen-und Umweltforschung mbH Munchen, and A. Coyle and H. Kalia of ONWI, October 1984.

REVIEWER: J. J. K. Daemen, Consultant DATE REVIEW COMPLETED: 3-4-85

BRIEF SUMMARY OF DOCUMENT: DATE APPROVED:

This first annual report describes experiments simulating nuclear waste emplacement effects at the 800-meter level of the Asse salt mine in the Federal Republic of Germany. Major experiments are brine migration and heater tests. The report describes the issues and objectives of the tests, the Asse salt mine, the salt properties in the test area, the experiment design, instrumentation, licensing procedure, hardware, and results. Measured data are given for the first six months of operations on brine migration rates, room closure rates, extensometer readings, stress measurements, and thermal mechanical behavior of the salt. Future work (ending in December 1985) is outlined.

SIGNIFICANCE TO NRC WASTE MANAGEMENT PROGRAM:

The Asse program provides a fairly large scale in situ experiment on the effects of heat and radiation on the mechanical, thermal, hydrological and chemical response of salt to simulated waste emplacement. The tests will provide an excellent opportunity to evaluate the predictability of salt response, in particular with regard to brine migration, strength (particularly hole wall decrepitation), creep (especially room closure), retrievability (when heaters and radioactive sources are to be recovered), gas development and pressure within the holes, and corrosion of various components emplaced within and near the hole, especially of metal test coupons. Some items of particular interest:

- Retrievability: the need for protection of the radiation sources, which must be removed upon completion of the test, is stressed repeatedly (e.g., page 10, last paragraph; p. 18, top paragraph; p. 22, last paragraph; p. 25, top paragraph; pp. 25-26, last and first paragraph respectively; p. 29 next to last paragraph; p. 41, third paragraph; page 45, Section 6.1, Licensing procedure, item 1, and last paragraph of section; page 116, paragraphs 2 and 3). Retrievability of the radiation source, upon test completion (i.e., two years after emplacement) is assured by the installation of a high strength steel sleeve with Inconel 600 cladding, and integrity of the sleeve is monitored continuously.
- Thermomechanical analysis: two finite element analyses performed to predict room closures give results that differ by a factor of three to four.

- Floor fracture: extensive fracturing of the floor above the heaters is taking place.
- Stress measurements: considerable difficulty has been encountered in calibrating stress monitoring instruments (stress gages and flat cells). Measured values, of questionable validity, differ drastically from predicted (calculated) values.

Summary: extremely interesting experiments, that deserve being followed closely.

DETAILS

p. 6, Figure 3-2: very difficult to read many details; it would be desirable to have back-up references.

p. 8, Figure 3-3: confusing. A few cross sections and plan views might clarify the stratigraphy.

p. 10, last paragraph: in order to assure that the radiation sources can be retrieved upon completion of the test (i.e., after two years), a steel sleeve is installed, and the integrity of the sleeve is monitored continuously.

p. 14, last paragraph: it is stated that the tests are designed to subject the test assemblies and the instrumentation to the environment that is expected to exist in an actual repository. Clearly this is only partially true, for example, the maximum temperature at the borehole wall reaches 207°C while higher temperatures are predicted for current repository designs (e.g., Deaf Smith County, Texas, 225°C--Draft EA, page 6-182; Davis Canyon Site, Utah, 235°C--Draft EA, page 6-186; Richton Dome Site, Mississippi; 296°C--Draft EA, page 6-183). The tests are separated by 15m to avoid interaction. At a 15m spacing some thermal interaction will take place according to present designs within one year after emplacement, and very considerable interaction within 5 years, and beyond.

Although the statement that "the tests are designed to subject the test assemblies and the instrumentation to the environment that is expected to exist in an actual repository" is a significant overstatement, this does not detract from the considerable value of these experiments.

p. 14, last paragraph: steel sleeves are used to protect the test material from the pressure and corrosive effects of the salt environment.

p. 15, Figure 4-4: dimensions on this figure probably are in inches. It would be desirable to indicate this on the figure.

p. 16, last paragraph: according to this paragraph the sleeves have a 0.75 inch wall thickness, while according to Figure 4-4, p. 15, the lower sleeve has a 1 inch wall.

p. 18, third paragraph: it remains unclear where borehole wall temperatures are measured: Figure 4-2, p. 12, shows thermocouples at four elevations, on p. 16, middle of second paragraph, is stated that borehole wall temperatures are measured at six elevations, in this section at five elevations, Figure 4-6 shows six elevations.

On p. 25, first paragraph of Section 4.2 Instrumentation, the statement is made that borehole wall temperature measurements are made at five elevations, and this is confirmed by the detailed description in the last paragraph on p. 26. Figures 7-le and lf show measurement results at six elevations.

p. 19, Section 4.1.6. According to this section the cannisters containing the radiation source have a 19.7 cm OD and 3 mm wall thickness, according to

Figure 4-5, p. 20, these dimensions are 17.8 cm and 4.8 mm respectively. Dimensions on Figure 4-6 correspond to the former (presumably all dimensions on this Figure are in inches). The second paragraph on p. 37 gives an OD of 19.8 cm.

p. 30, Section 4.2.7, first paragraph. The figure reference at the end of the first sentence probably should be to Figure 4-3 which shows the extensometer positions, rather than to Figure 4-1.

p. 31, Section 4.3, paragraph 3. According to the last sentence of this paragraph the data can be output on paper or foil-type type tape, printed, or stored on magnetic tape. One would hope that this should be and, i.e., that all data is stored on magnetic tape.

p. 44, Table 5-2. It is regretable that only averages are given, and that testing methods are not described in more detail.

p. 46, Section 6.3, second paragraph: cobalt source activities are about 8% lower than design activities (p. 37, last paragraph; p. 35, Section 4.6.1, first sentence; p. 35, last paragraph).

p. 50, Section 7.1. Pre-test calculations underestimated the heater power requirements by almost 20% in the nonradioactive holes, were correct in the radioactive holes.

p. 60, last paragraph, and Figure 7-2, p. 63: after 200 days about 40% less brine has been collected than had been predicted.

p. 62, first paragraph: hydrogen, hydrogen cloride and hydrocarbons developed in all holes.

p. 90, Figure 7-8h. Are the seemingly eratic results due to an instrumentation problem?

p. 92/93, Section 7.4.5. Comparison of Measured and Calculated Data

It is very clear from Figures 7-4b (p. 73), 7-5b (p. 77), and 7-7 (p. 81) that the results obtained from the two finite element analyses are significantly different (and, contrary to the assertion on p. 92, they remain significant after start up of heating).

A partial explanation for the differences is given in the last paragraph on p. 92, however the statement could be made more forcefully, in that the mesh (Figure 7-9a, p. 93) used for the DAPROK analysis is totally inappropriate: the vertical boundary is far too close to the opening, i.e., this mesh can not possibly simulate a boundary at a great distance from the excavation.

No details are given on the MAUS analysis, and the reference is not available, but given the simplifications (e.g., two-dimensional analysis, crude mesh near room contours), the results from the calculation match the measurements reasonably well.

It is of interest to note that the more detailed discussion of the DAPROK calculations in reference 1 (ONWI-242, p. 159) includes a prediction that the actual room closures are likely to be larger than the calculated ones, while the results reported on here indicate quite the opposite.

p. 116, Section 8.1: extensive fracturing of the holes is expected during cooldown: problems are envisioned for removing the radioactive sources from the holes while the site is hot, even though sleeves are used.

p. 120, two last conclusions:

-While it is true that test equipment and instrumentation apparently stood up very well to a harsh environment, it remains very unclear what the stressgages and flat cells are really measuring.

-The conclusion that measured room closures are very close to the predicted values is not warranted, or certainly overstated.

SALTS
&
BRINES '85

PROCEEDINGS OF THE SYMPOSIUM
SOLUTION MINING OF SALTS AND BRINES
NEW YORK, NEW YORK—FEBRUARY 25-26, 1985

Editor

W. Joseph Schlitt

Associate Editor

William C. Larson

Sponsors

**SOLUTION MINING COMMITTEE
OF THE MINING & EXPLORATION DIVISION
AND
INDUSTRIAL MINERALS DIVISION
SOCIETY OF MINING ENGINEERS, INC.**

Published by the
Society of Mining Engineers
of the
American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc.
New York, New York • 1985

TABLE OF CONTENTS

MINERAL RECOVERY